



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE
NAME

CENTRE
NUMBER

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BIOLOGY

9700/04

Paper 4 A2 Structured Questions

May/June 2008

2 hours

Candidates answer on the Question Paper.

Additional Materials: Answer Paper available on request.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

Answer **all** questions in Section A and **one** question from Section B.
Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

| For Examiner's Use | |
|--------------------|--|
| Section A | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| Section B | |
| 9 or 10 | |
| Total | |

This document consists of **20** printed pages, **4** lined pages and **4** blank pages.

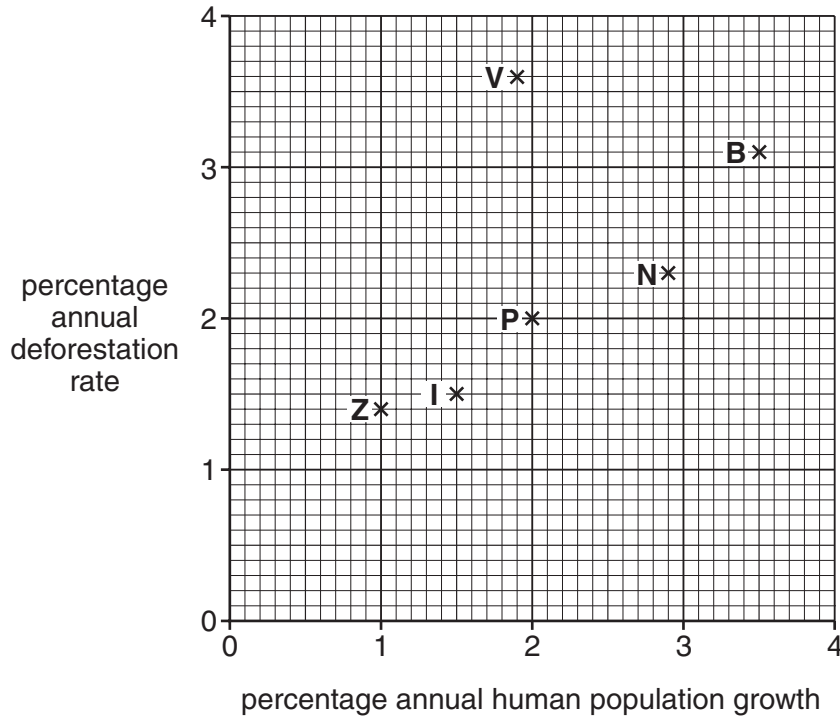


Section A

Answer **all** the questions.

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- 1 (a) Fig. 1.1 shows the relationship between annual deforestation rates and annual human population growth for six countries.



- B** – Burundi
- I** – Indonesia
- N** – Nigeria
- P** – Philippines
- V** – Vietnam
- Z** – Zimbabwe

Fig. 1.1

Describe the relationship shown in Fig. 1.1.

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..... [2]

(b) Over half of the species of plants and animals comprising the biodiversity of the Earth are thought to exist in tropical rainforests.

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(i) Explain the meaning of the term *biodiversity*.

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..... [2]

(ii) Explain the economic reasons for maintaining biodiversity.

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..... [4]

[Total: 8]

- 2 Fig. 2.1 is a light micrograph of a small part of the pancreas.

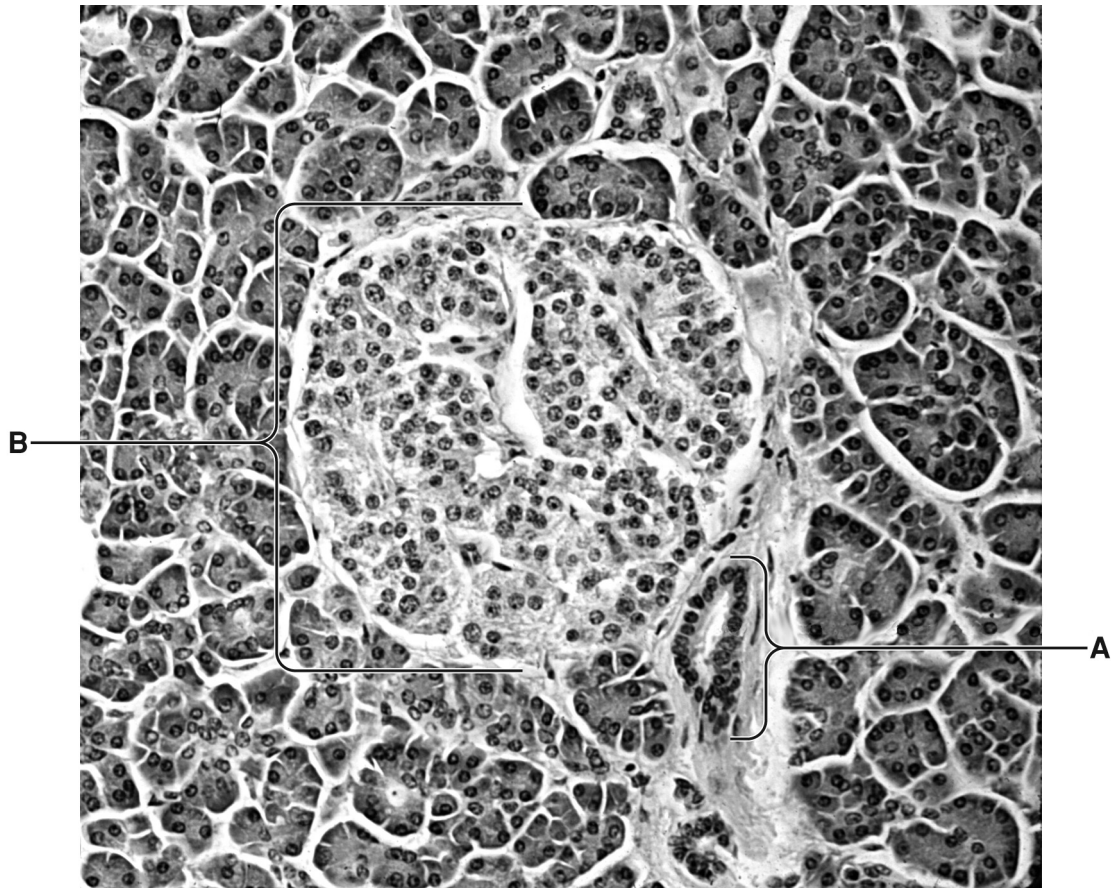


Fig. 2.1

- (a) Name structures **A** and **B**.

A

B [2]

- (b) With reference to Fig. 2.1, explain why the pancreas is an *endocrine gland*.

.....

 [2]

(c) Insulin and glucagon are involved in the control of blood glucose concentration. When blood glucose concentration rises, secretion of insulin increases.

Outline two ways in which insulin affects the activity of cells in the liver.

- 1.
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- 2.
..... [2]

(d) Some forms of diabetes are caused by an inability to secrete insulin and can be controlled by regular injections of insulin. Most of this insulin is now produced using genetically modified *Escherichia coli*.

Explain the advantages of using this type of insulin, rather than insulin obtained from animal sources.

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- [2]

[Total: 8]

3 (a) Fig. 3.1 shows the male and female flowers of maize.

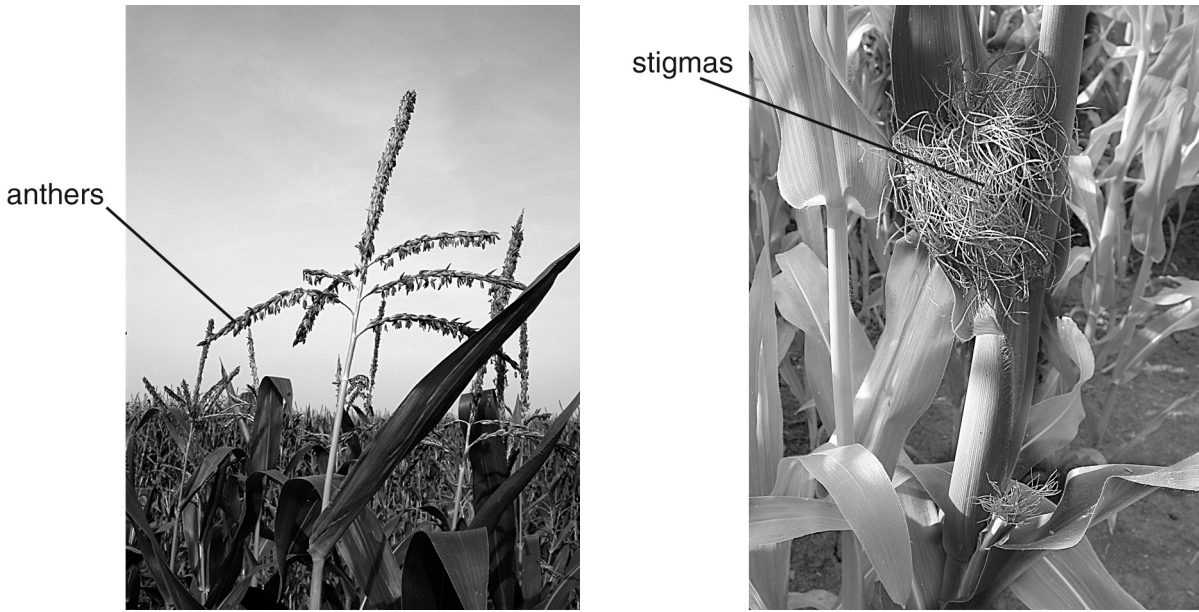


Fig. 3.1

(i) With reference to Fig. 3.1, describe how the flowering habit of maize encourages wind-pollination.

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.....[3]

(ii) In a maize plant, the anthers normally ripen before the stigmas are mature and ready to receive pollen. This encourages cross-pollination.

Explain the potential advantages of cross-pollination to a plant species.

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.....[3]

- (b) Cultivated maize is related to a wild Mexican grass, teosinte. Teosinte looks very different from maize. In particular, teosinte has a very hard layer surrounding the fruit, making it impossible to use as an edible grain.

Archaeological excavations have found that maize in its edible form dates back at least 4000 years. It has been argued that the structural differences between teosinte and maize grains are so great that it is unlikely that maize could have been bred from teosinte so long ago.

Investigations have been carried out into the genetic differences between teosinte and maize. A gene on chromosome 4, *tga 1*, containing 1042 base pairs, was found to be responsible for all of the structural differences between teosinte and maize.

Fig. 3.2 shows the DNA base sequence of the only part of *tga 1* that always differs between teosinte and maize.

| | | | | | | | | | | |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| teosinte | GAT | TGG | GAT | CTC | AAG | GCG | GCG | GGC | GCG | TGG |
| maize | GAT | TGG | GAT | CTC | AAC | GCG | GCG | GGC | GCG | TGG |

Fig. 3.2

- (i) Outline the principles of electrophoresis as used in sequencing this DNA.

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..... [4]

(ii) Suggest how the difference in the base sequence of the *tga 1* gene shown in Fig. 3.2 could cause large differences in phenotype between teosinte and maize.

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.....[2]

(iii) With reference to Fig. 3.2, explain how these results support the suggestion that it would have been relatively easy for early farmers in Mexico to have bred maize from teosinte.

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.....[3]

[Total: 15]

4 (a) Outline the role of calcium ions in the transmission of nerve impulses.

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..... [3]

(b) It has been suggested that during maturation of a sperm, the uptake of calcium ions is necessary to produce the vigorous movements of the sperm's flagellum that allow it to penetrate the zona pellucida of an oocyte.

Uptake of calcium ions can be measured by staining the sperm with a non-toxic fluorescent stain. Fluorescence increases as the concentration of calcium ions inside the sperm increases.

Sperm from two types of mice were investigated:

- wild-type mice, whose sperm have a particular protein, **P**. **P** is an ion channel found in the plasma (cell surface) membrane.
- mutant mice whose sperm did not have protein **P**.

The results of the investigation are shown in Fig. 4.1.

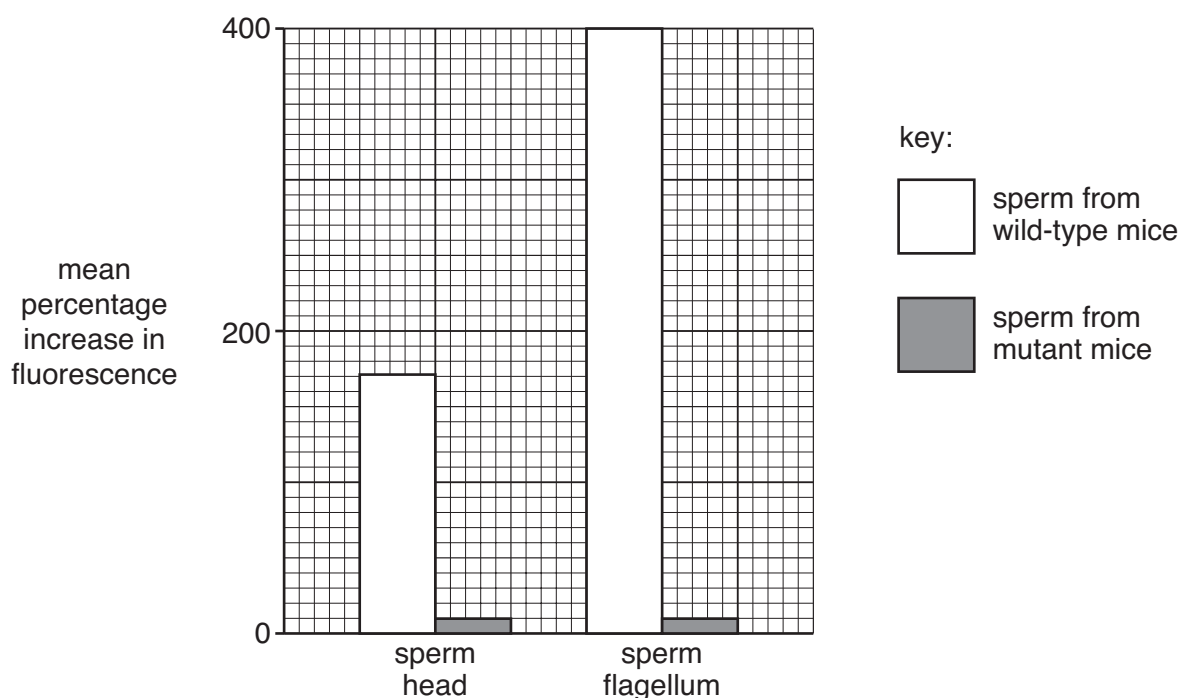


Fig. 4.1

With reference to Fig. 4.1, describe and explain the different mean percentage increases in fluorescence of

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(i) sperm from wild-type and mutant mice,

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.....[3]

(ii) sperm heads and flagella.

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.....[3]

(c) The ability of sperm from wild-type and mutant mice to penetrate oocytes was tested using in-vitro fertilisation (IVF) of oocytes with and without a zona pellucida. The results are shown in Fig. 4.2.

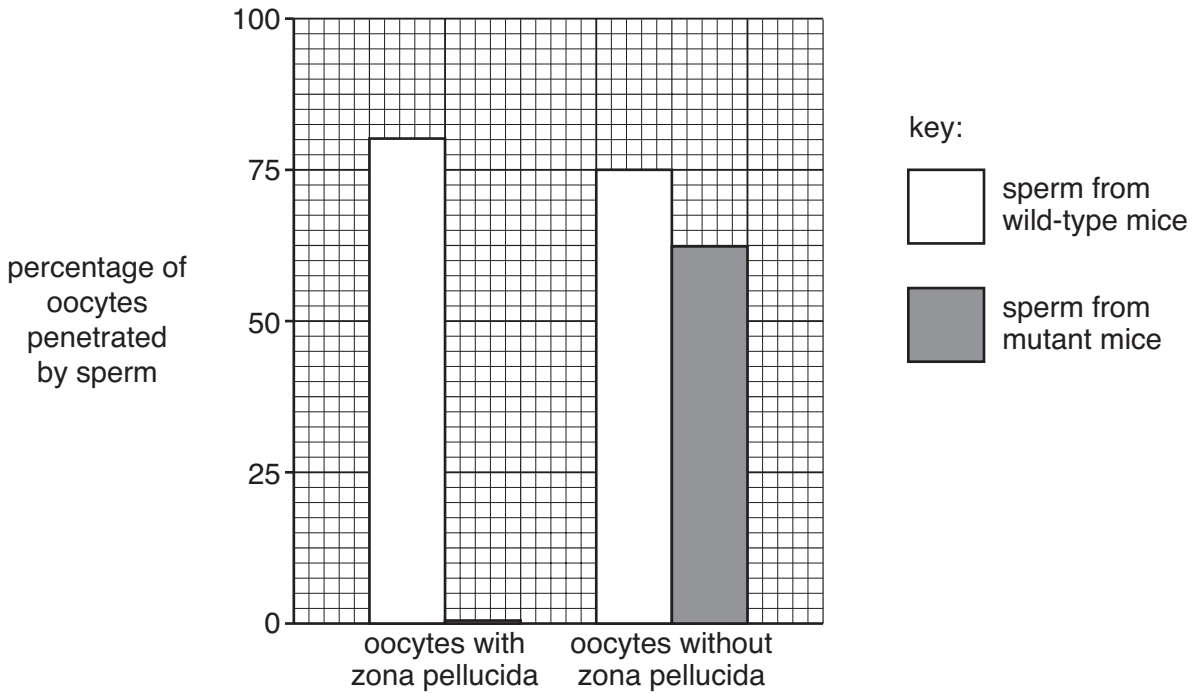


Fig. 4.2

(i) Explain what is meant by *in-vitro fertilisation*.

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..... [2]

(ii) With reference to Fig. 4.2, explain the differences in the ability of sperm from wild-type and mutant mice to penetrate oocytes in IVF.

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..... [4]

[Total: 15]

Question 5 starts on page 14

- 5 A significant quantity of the metallic copper produced in some countries is obtained using the chemoautotrophic bacterium, *Thiobacillus ferro-oxidans*, which is present in rocks in many countries.

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The process, known as bioleaching, is shown in Fig. 5.1.

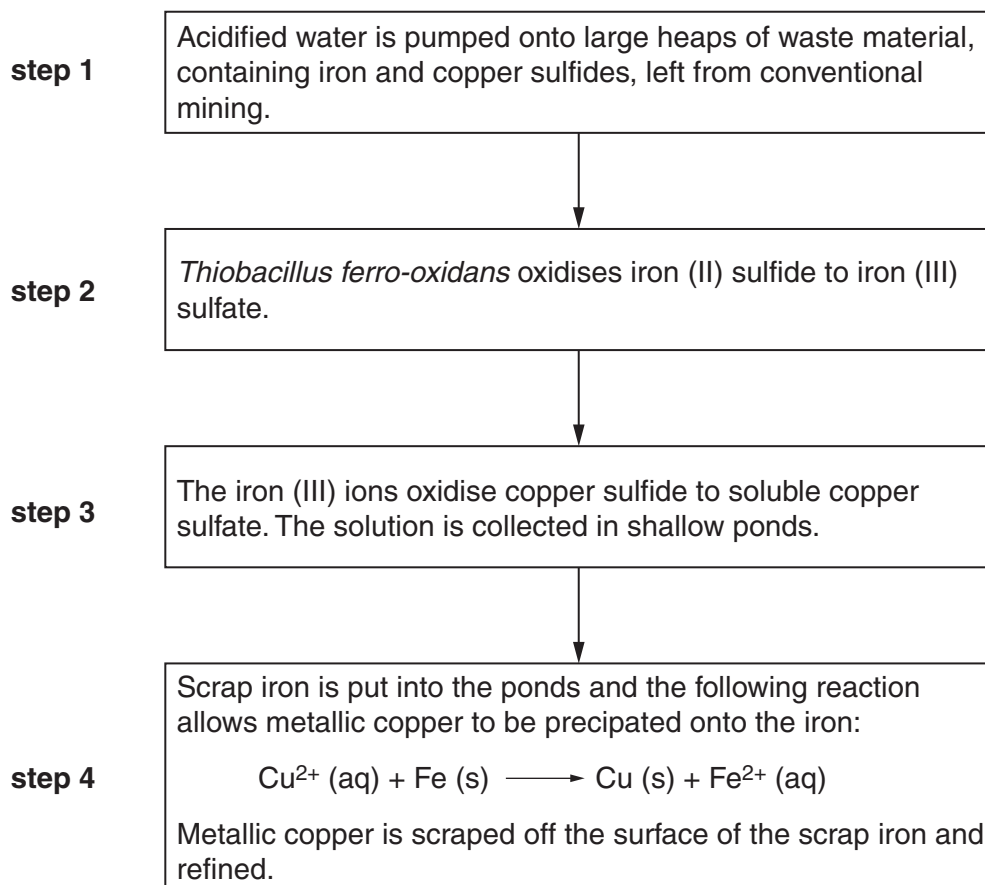


Fig. 5.1

- (a) Suggest the benefit to the bacterium of **step 2**.

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..... [2]

(b) State two environmental disadvantages of extracting metals by bioleaching.

- 1.
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- 2.
..... [2]

(c) Explain why the production of metallic copper by bioleaching can be cheaper than using conventional mining methods.

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..... [4]

[Total: 8]

6 Colour blindness is a condition characterised by the inability of the brain to perceive certain colours accurately.

- The most common form is termed red-green colour blindness (RGC).
- RGC results from a recessive allele.
- 0.6% of females worldwide have RGC.
- 8.0% of males worldwide have RGC.

Fig. 6.1 shows the occurrence of RGC in one family.

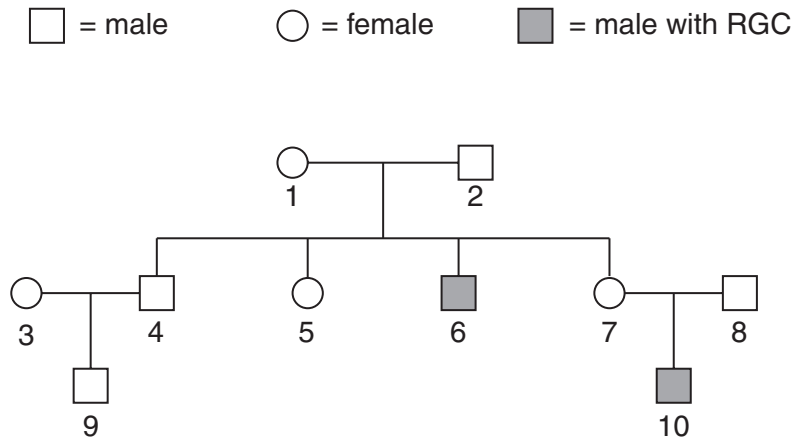


Fig. 6.1

(a) Explain the meaning of the terms *allele* and *recessive*.

allele
 [1]

recessive
 [1]

(b) Explain why females are less likely than males to have RGC.

.....

 [2]

(c) With reference to Fig. 6.1, and using the symbols **R** for the dominant allele and **r** for the recessive allele, state the genotypes of the individuals **1**, **4**, **6** and **7**.

1
4
6
7 [4]

[Total: 8]

Question 7 begins on page 18

7 (a) An **absorption spectrum** is a graph of the absorption of different wavelengths of light by a photosynthetic pigment.

An **action spectrum** is a graph of the rate of photosynthesis at different wavelengths of light.

Fig. 7.1 shows the absorption spectra of chlorophyll a and chlorophyll b as well as an action spectrum.

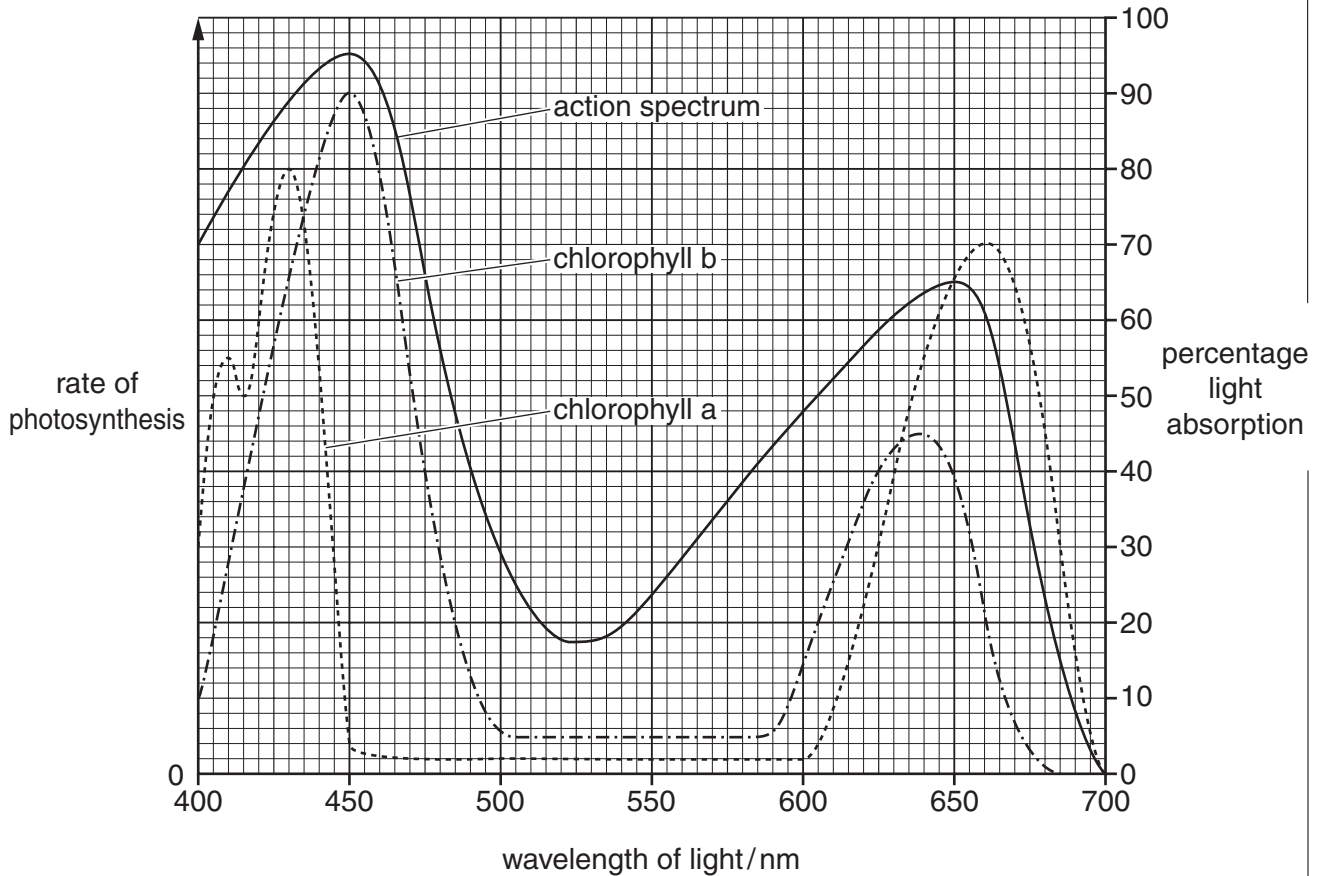


Fig. 7.1

With reference to Fig. 7.1,

(i) compare the **absorption** spectra of chlorophyll a and chlorophyll b,

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[3]

(ii) explain the shape of the **action** spectrum,

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..... [3]

(iii) explain why plants appear green .

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..... [2]

(b) Fig. 7.2 is an electron micrograph showing a section through part of a chloroplast.

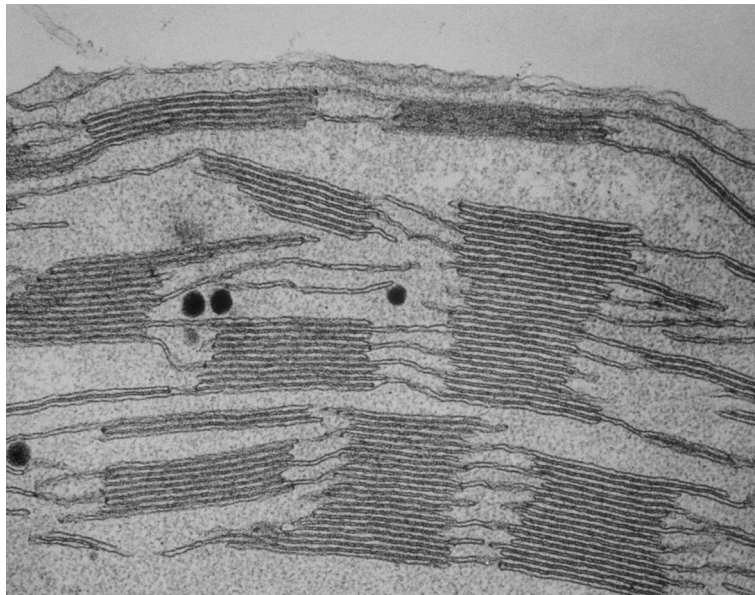


Fig. 7.2

On Fig. 7.2, draw label lines and use the letters **W** and **Y** to identify the following structures:

- **W** where the light-independent reactions occur
- **Y** where chlorophyll is found

[2]

Question 8 begins on page 22

- 8 The Atlantic herring, *Clupea harengus*, lives in large populations called shoals and may grow up to 40 cm long.

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Fig. 8.1 shows the appearance of *C. harengus*.

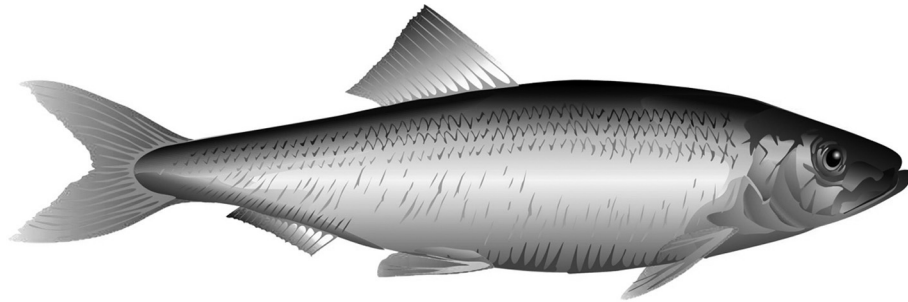


Fig. 8.1

The length of *C. harengus* shows wide variation.

Fig. 8.2 shows the numbers of fish of different lengths in a population of *C. harengus*.

The arrows show the selection pressures, **P** and **S**.

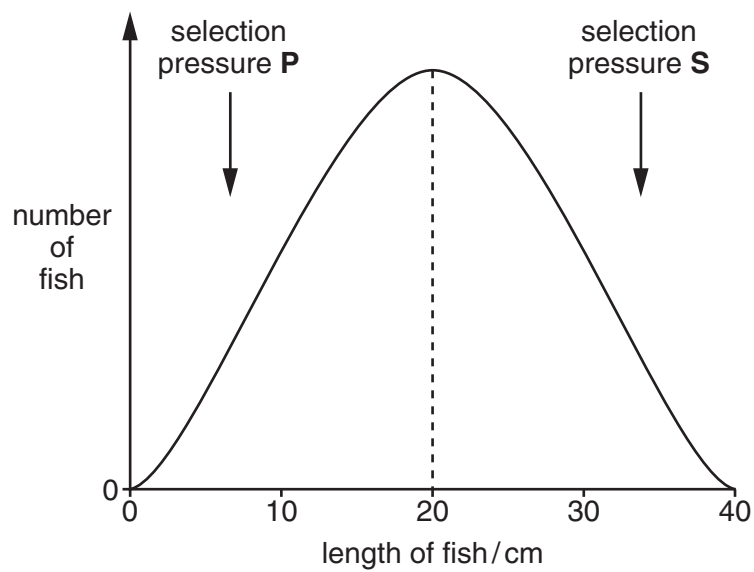
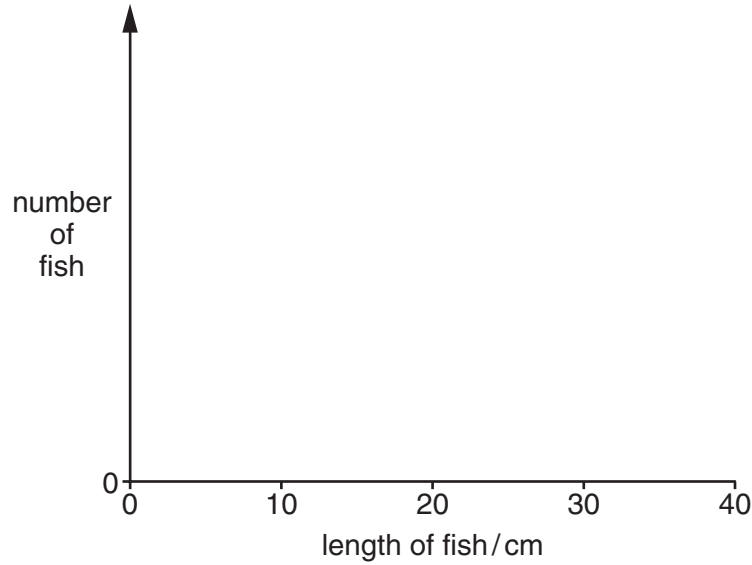


Fig. 8.2

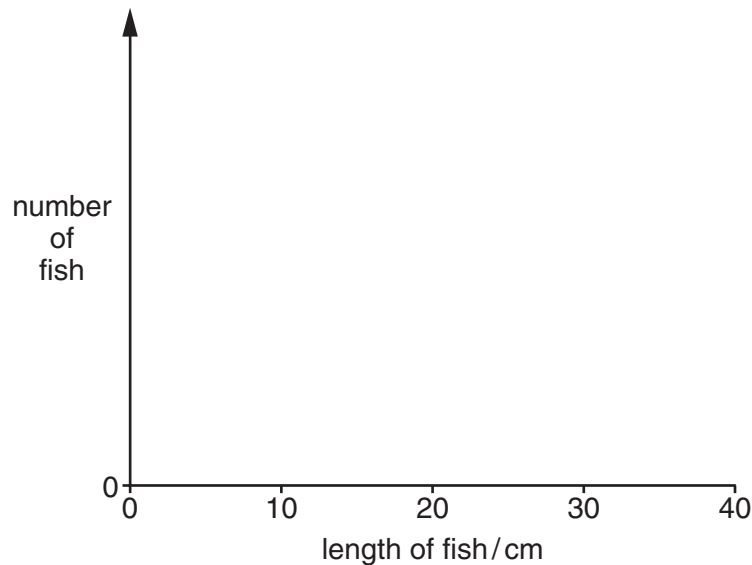
- (a) (i) Sketch a graph on the axes below to show the distribution of length of *C. harengus*, when selection pressures **P** and **S** operate for a few years.



[2]

- (ii) Name this type of natural selection [1]

- (b) (i) Sketch a graph on the axes below to show the distribution of length of *C. harengus*, when selection pressure **S** alone operates for a few years.



[2]

- (ii) Name this type of natural selection [1]

- (iii) Suggest two examples of selection pressure **S**.

1.

2. [2]

[Total: 8]

